TELECOMMUTING AND TRAVEL : A LITERATURE REVIEW COMPARISON

Diana MOHAMAD, Stephen HAMNETT, Matthew ROFE
School of Natural and Built Environment
University Of South Australia
SA 5000, South Australia
dm82_halu@yahoo.com, steve.hamnett@unisa.edu.au, matthew.rofe@unisa.edu.au

ABSTRACT

Sharing linked to the notion of teleworking, telecommuting is referred to as work arrangements where traditional workplace and the needs of physical travel are substituted by a remote workplace and telecommunications technologies. Surprisingly as it may seem, for an idea that has attracted so much interest and curiosity, there is no simple agreed definition. Most authors, researchers and even policy makers who claim to be concerned with the future of work have used the term without defining it precisely (Korte and Wynne, 1996). Understanding the previous, present and to date research studies on travel in terms of factors that influence such phenomenon as well as response to changes in circumstances that matters are an important component in assessing and projecting future travel-related issues and matters. Defined as 'trip or multi-trips made from origin to destination' or 'moving any distance by any means of transportation' (Mokhtarian, Salomon and Redmond, 2001), travel whether in the form of vehicle mode or non-vehicle mode, has always been part of human daily activity. This paper attempted to draw some conclusion with regard to impacts of telecommunications on travel in terms of the length of the trips made as well as the quantity of the trips made.

Keywords : telecommunication, travel length, travel behavior.

1. INTRODUCTION

There is no uniform definition for telecommuting, also known as teleworking – term used in Europe. Using three dimensions in describing teleworking, Korte (1988) depicted telework as :

1. Location : teleworkers and/or organization needs will determine the work's location as desired or needed which in turn implied that the work's geographical site is independent of employers' location.
2. Use of IT : this type of work arrangement depends either fully or largely on the use of IT.
3. Communication link to employer : results of work will be delivered to employers using electronic communication such as disc, cassette, fax (in the narrow sense) or using traditional media for instance mail, courier (in the broader sense).

The literature of telecommuting dates back principally to the late 1960s and early 1970s. It was assumed that the level of teleworking diffusion and penetration would be by way of a rather slow, but constant evolution (Korte and Wynne, 1996). Following is the list of teleworking arrangements where telecommuting is one of them (Vittorio Di Martino, 2001):

1. *Tele-homeworking* : home-based telecommuting;
2. *Neighborhood centres* : non home-based telecommuting which belongs to the local authority;
3. *Telecenters* : not necessarily closed to the employees resident. Technology equipped in the centres was properly for long distance working environment;
4. *Virtual office* : the nature of employee's position requires that their primary duties be performed "on the road" or at a customer's worksite;
5. *Touchdown centres* : worksite is located in other company's building.
6. *In call centres* : worksites for communication's operators;
7. Transborder telecommuting : employer and employees are separated geographically;
8. *Full-time Home-Telecommuting* : at-home office or workstation within the same metro area as the normal office.

Understanding the previous, present and to date research studies on travel in terms of factors that influence such phenomenon as well as response to changes in circumstances that matters are an important component in assessing and projecting future travel-related issues and matters. Defined as 'trip or multi-trips made from origin to destination' or 'moving any distance by any means of transportation' (Mokhtarian, Salomon and Redmond, 2001), travel whether in the form of vehicle mode or non-vehicle mode, has always been part of human daily activity. Timmermans et. al (2003) well thought-out travel into two positions namely (1) trip which defined as movement between two activities carried out at different locations and (2) tour which defined as a sequence of trips where it starts and ends at the same location. To date, studies focusing on travel have it classified and categorized travel into different groups depending on the travel-related field studied as well as by the breadth of the domains which they are likely to affect.

This paper serves the purpose of providing an initial overview of literature which is relevant to the proposed topic, on telecommuting and on research studies to date. The contents of this section have been divided into two subtopics – (A) background of the theory and practice of telecommuting, (B) international case studies which will give an insight of the advantages and disadvantages of telecommuting. The definition of telecommuting, the types of jobs which seem appropriate for telecommuting will be discussed as part of (A).

The purpose of undertaking the case studies is to illustrate telecommuting practice and to review the results of the studies, which have sought to introduce this work arrangement as an alternative to travel. Nevertheless, these case studies have assisted in gaining a broad understanding of the subject's nature as well as of the level of penetration and of the potential of telecommuting. The literature review also plays a role as 'methodology mining' i.e. suggesting possible research approaches for the proposed study.

2. BACKGROUND

In deciding the types of jobs appropriate for telecommuting, there appears to be a consensus that jobs that require less interaction with people and more handling information, such as reports as well as transaction-based activities, are most suitable for telecommuting. Researchers, writers, programmers, accountants and engineers are some of the prime candidates for telecommuting. However on the other hand, Mokhtarian (1998, as cited in Bailey and Kurland 2002) argue that idiosyncratic details of employee's job will determine whether it is suitable for telecommuting or not. Mokhtarian and Salomon (1996, as cited in Bailey and Kurland 2002) also arrive at the same conclusion where employees' self-perceived and self-attitude sufficiently relates with their choice to telecommute. Furthermore, Bailey and Kurland (2002) find that besides the factors discussed above, status and power may influence with the assessments of individual who can carry out the telecommuting programme in general and teleworking arrangement in particular.

In practice, people are using the same terminology to describe various things and this has lead to the distortion of the term. The following lists of some widely used telecommuting definitions:

1. '*telecommuting provides employees with the opportunity to perform their duties at alternative worksites during an agreed-upon portion of their work week*' (FAA Telecommuting Handbook, 1997);
2. '*working at home or a location closer to home than the regular workplace, using information and communication technology (ICT) to support productivity and communication*' (Choo, Mokhtarian and Salomon, 2004);
3. *The capability of individuals to work at home and communicate with their offices by using personal computers and communications equipment and software* (Noorliza and M. Hasmi, 2000);
4. *Employees work predominantly outside of their home offices, but are associated with traditional office and may be used traditional office from some administrative support and to hold physical meeting* (Knight and Westbrook, 1999).

Much similar to Korte's definition, Lars Qvortrup (undated) who agrees that the definition of telecommuting is solely based on its nature limitation (namely fragmentation, dispersion and diffusion) summarizes that in all definition, computers and/or telecommunications are identified with telecommuting, which also exclusively focus on the relationship between workplace and employer's centre. Lars Qvortrup has summarized that the definition of telecommuting can be specified into three organisational phases:

1. Seen as teleworking corresponding definition, telecommuting is defined as *working at home instead of in a central office*, where this kind of working arrangement substitutes telecommunication for daily commuter's trip to and from workplace.
2. Characterised by dispersion of traditional organisations, teleworking is said to take place when works are done in decentralized satellite offices and local work centres.
3. Works that based on computer conferencing networks is called networking where traditional office is no longer in used.

3. LITERATURE COMPARISON

The purpose of the State of California Telecommuting Pilot Project was to assess and to scrutinize the impacts of telecommuting on travel behavior and related issues in personal vehicle emissions level. In this study, the impacts of home-based telecommuting were analyzed using 'a comparison of participants' telecommuting day travel behaviour with their before-telecommuting travel behaviour' (Koenig, Henderson and Mokhtarian, 1996). Four travel-related indicators were analyzed – vehicle miles travelled, number of vehicle trips, number of cold starts and number of hot starts. Ed Glover and Penny Carey (2001) define cold start as engine that has been left for 12 hours overnight soak period before started and hot start as engine that has lasts for 867 seconds over a length of 3.91 miles before it started once again. Meanwhile, three effects were analyzed in this study, namely:

1. the person effect : sample (telecommuter and the control groups) is compared in order to determine whether they are statistically similar
2. the wave effect : computes differences between before and after measures to pool samples and increase robustness
3. the day effect : characterized by the telecommuting day or non-telecommuting day status (telecommuting day refers to days when telecommuting is performed by the telecommuters).

The study found telecommuting caused an increase in the number of non-commute trips signifies that telecommuters made more frequent but shorter non-commute trips on their telecommuting days (for example going out for lunch). Similar findings can be found in Henderson and Mokhatarian (1996) and Balepur et al (1998) (as cited in Mei-Po Kwan, Martin Dijst and Tim Schwanen, 2007) where there seems to be a slight increase in non-work travel as a result of center-based telecommuting. This supports the tendency for non-work activities and trips to increase as a result of higher level use of ICT. It is extremely

significant to note that the reduction obtained from this study only applies to telecommuters themselves, not to the population as a whole. In this regard, any assessment of the aggregate impacts of telecommuting must take into account how many people are telecommuting at one time and how often these people telecommute. This study also found that as a potential negative impact of telecommuting, non-commute trip generation should continue to be studied due to noteworthy empirical results.

In another study by Niles (1996) addressing the impact of telecommuting on transportation (the subject of this study is a specific group of about 400 full-time employees (telecommuters) where they represented a great variety of types of jobs) using trip logs survey, the study reported the following results (Niles, 1996):

1. Telecommuters with 96.6 percent of trips logged (by car) were slightly more intensive car users than the members of control group with 92.7 percent of trips;
2. Telecommuters do make trips on telecommuting days (about 70% to 80% of the trips are to and from principal office) which are relatively short (averaging 4 miles over the work week);
3. Average telecommuters' reduction of daily car mileage is 30 miles albeit trips are being made during the telecommuting days.

Based on the findings for the transportation impacts, this study concluded that there are noteworthy figures of reduction in telecommuters' commute savings. For this reason, the hypothesis that 'telecommuting acts reduce car use over and above the commuting related reduction' is supported by the results of this study which lead to consensus that telecommuting can be seen as one of the means of reducing trip generation. The conclusion of this study was that :

1. Telecommuting may have the potential of inducing demand for long-distance travel but telecommuters are already largely travel-saturated. Even though the situation is depicted as it is, telecommuting may not substantially increase their total travel
2. There is no evidence supporting the hypothesis that telecommuting induces longer vacation trips

Markus Robert (2003) sought to investigate and explore the relationship between information technology (IT) and individuals' preference of travel, by using econometric modelling. The purpose of this study was to assess whether IT would help in reducing physical travel need, have no impact at all on total travel distances or actually play a role in creating even more trips. This study was conducted with the aim of identifying the changes (factors) that could make teleworking arrangements more relevant and more attractive to employees. Serving as the study's sample, IT-companies in Stockholm were chosen because of the efficient transport alternatives provided for the employees. By experimenting with these IT attributes (efficient travel booking and payment systems, traffic information in vehicles and WAP-information about scheduling as well as delays) the study sought factors likely to influence changes in travel behaviour. This study concluded that IT indeed possesses an immense and latent potential to save resources, and therefore has a role to play in the discussion about reducing travel demand. Based on this and previous studies on this subject, there seems little doubt that there is potential to substitute telecommunication for physical travel. But for the latent potential to be realised, telecommunication has to offer accessibility to new feasible alternatives in terms of information as well as incentives for example route real-time information (Markus Robert, 2003).

Choo and Mokhtarian (2004) used eight endogenous variables categories and one exogenous variable category, in seeking to understand the aggregate causal relationships between telecommunications and travel. Demand, supply, costs, land use, economic activity and socio-demographic (exogenous variable) are the subjects investigated. Focusing on a conceptual model, this study indicated that relationships between travel demand and telecommunications demand did exist (even though not all physical travel needs can be and will be substituted by telecommunications) in terms of bi-directional causality: positive interaction (Niles 1996 and Miller 2001) or negative interaction (Mokhtarian 1998 and Akerman 2000). The relationships' hypothesis is supported by obtaining the same results (telecommunications indeed affect travel demand complemented each other) from all models (single-equation model and structural equation model of travel and telephone calls).

By using structural equation model of travel and telephone calls, it was shown that the relative impact of travel demand on telecommunications demand is stronger than the other direction. Simply put, it indicates that telephone calls play a minor role in stimulating travel. That is to say, for example, before and after a trip to a meeting being made, telecommunications are used to set up the meeting (before travel) and are also used in activating other activities (after travel) initiated by the trip (for meeting purpose). Other than that study found that mobile phone may increase physical travel need (trips generated as a result of last minute preparation) and it also can work as an advanced information system tool which enables a better and more efficient preparation (Choo and Mokhtarian, 2004).

Mei-Po Kwan, Martin Dijst and Tim Schwanen (2007) in their paper 'The interaction between ICT and human activity-travel behaviour' listed the following findings namely telecommuters not only substantially reduced their trip making and the total traveled distance which the same results as Niles's study in the abovementioned paragraph (cited in Pendyala et al, 1991 and Koenig et al, 1996) but also telecommuters tend to chose non-work destinations or shared activities are performed closer to home (as cited in Pendyala et al, 1991 and Saxena and Mokhtarian, 1997). In other study by Nobis and Lenz (2004) the similar results obtained as Nilles (1996) where heavy ICT users tend to be heavy car users (cited in Feng Zhang, Kelly J Clifton and Qing Shen; 2005). Hjorthol's (2002) results stays on the same page as Nilles (1996) and Feng Zhang, Kelly J Clifton and Qing Shen (2005) where the conclusion derived is that 'using a home computer with or without Internet connection have a small but statistically positive effect on daily distance traveled (cited in Feng Zhang, Kelly J Clifton and Qing Shen; 2005).

Cairns S, Sloman L, Newson C, Anable J Kirkbride A and Goodwin P (2004), listed a summary of other findings of telecommuting/teleworking researches:

Finding (s)	**Researched by**
Reduction in car trips to work	Koenig et al (1996), Mokhtarian et al (1998), Belapur et al (1998), Hamer et al (1991), Glogger et al (2003), Hop Associates (2001), Geraghty (2004), Fogarty (2004), HOP Associates (2002-2003), SustainIT (2002)
More frequent non-work car trips on teleworking days	Mokhtarian et al (1998), Belapur et al (1998), Hopkinson et al (2001)
Less time spent for traveling	Jensen et al (2003)
Workplace relocation	Jensen et al (2003), Hopkinson et al (2001)
Telecommuter average commute distance is longer than average national commute journey	Mitchell et al (1994), DTLR (2002)
Reduction in car commuting traffic	Dodson et al (2002), Lake et al (1997), Illegems et al (2003), Martens et al (1999)

Ville Helmien and Mika Ristimäki (2007) found that telework indeed reduced the total kilometers traveled in Finland by 0.7%, however the results only applied to distance travel below 100 kilometers. In cases where traveled distance exceeds 100 kilometers, travel is substitute with second apartment which is near to the working place. The same results obtained as Mitchell et al (1994) and DTLR (2002) where teleworker's average commute distance is longer than average national commute journey. This study concluded that length of the commuting trip does not appear to have an independent role in determining teleworking.

Feng Zhang, Kelly J Clifton and Qing Shen (2005) in 'Reexamining ICT impact on Travel Using the 2001 NTHS Data for Baltimore Metropolitan Area' found that approximately half a trip difference between high frequency internet users and those with no access to internet while on the other hand, medium frequency internet users will increase the number by approximately 0.466. Though the number is small, it suggested a complementarity relationship between internet use and travel. Further, this study also showed a small but significant effects of business telephone on travel behavior in the form of substitution effect.

4. CONCLUSION

In conclusion, telecommuting indeed has the potential to reduce the needs for physical travel. However, none of the case studies presented above showed results of the total average daily VMT. Furthermore, recent studies of telecommuting have been focusing on the impact of telecommunications on travel demand specifically on the relationship between IT technology and urban structure (Mokhtarian, Collantes and Gertz, 2003; Zhang, Clifton and Shen, 2005), compared to studies on the relationship between telecommuting and higher education institution (Dholakia, Mundorf, Dholakia and Xiao, 2004). Therefore, this proposed study will be focusing on academics' travel behaviour and will examine the extent to which e-education can reduce the academics' travel needs by substituting telecommunication. Typical telecommuting weeks will be establish for examining the changes in respondents' travel patterns and travel behaviour. Typical telecommuting weeks are weeks where respondents' telecommuting frequency is at maximum level and respondents' activity pattern is the same.

PRIMARY REFERENCES

Bailey, E.D and Kurland, B.N (2002). *A Review of Telework Research : Findings, New Directions and lessons for the Study of Modern Work.* Centre for Work, Technology and Organization, Department of Management Science and Engineering, Stanford University, USA.

Cairns S, Sloman L, Newson C, Anable J Kirkbride A and Goodwin P (2004). *Smarter choices – Changing the way we travel*. Department for Transport, London.

Choo, Sangho and Mokhtarian, Patricia L (November 2004). *Does Telecommunications Affect Passenger Travel Or Vice Versa*? *Structural Equation Models Of Aggregate U.S Time Series Data Using Composite Indices*. TRB 2005 Annual Meeting.

Ed Glover and Penny Carey (November 2001).. Determination of Start Emissions as a Function of Mileage and Soak Time for 1981-1993 Model Year light-Duty Vehicles. U.S Environmental Protection Agency.

Feng Zhang, Kelly J Clifton and Qing Shen (2005). *Reexamining ICT impact on Travel Using the 2001 NTHS Data for Baltimore Metropolitan Area.* University Of Maryland, USA.

Koenig, Brett; Henderson, Dennis and Mokhtarian, Patricia (1996). *The Travel and Emissions Impacts of Telecommuting for the State of California Telecommuting Pilot Project*. Institute of Transportation Studies, University of California.

Korte W.B and Wynne R (1996). *Telework : Penetration, Potential and Practice in Europe*. IOS Press Ohmsha.

Markus Robert. *Information Technology And Individual Preferences Of Travel- A Theoretical Framework*. Royal Institute Of Technology, Stockholm, Sweden.

M. Hasmi Abu Hassan and Norliza Karia. *Factors Toward Telecommuting : An Exploratory Study*. University Sains Malaysia.

M. Hasmi Abu Hassan and Norliza Karia. *Telework Concept : An Exploratory Study- Learning From Malaysia's Experience*. Universiti Sains Malaysia.

Nilles Jack M (1996). *What Does Telework Really Do to Us?.* World Transport Policy & Practice 2/1-2 (1996) 5-23. MCB University Press.

Vittorio Di Martino (2001). *The High Road To Telecommuting*. Geneva.

SECONDARY REFERENCES

A. Read (February 2000). *Telecommuting Spawns Concerns*.

Ab. Rahman (undated). *Transport and Communication for Urban Development Car Poling in Kuala Lumpur Public Perception*. University Technology of Malaysia.

Barter P.A. *Transport Dilemmas In Dense Urban Areas : Examples from Eastern Asia.* Sustainable Urban Forms for Developing Countries, pp. 271-284 (London Press).

Barter P. A. *Transport, Urban Structure and lock-in in The Kuala Lumpur Metropolitan Area.* International Development Review, 26 (1), 1-24.

Derrick J.Neufield and Yulin Fang (2004). *Predicting Telecommuter Productivity*. Proceedings of the 37th Hawaiian International Conference on Systems Science.

Hamsa, Abdul Azeez Kadar Hamsa and Ahmad, Supian (1995). *Impact Of Telecommuting On Urban Form And Urban Travel : Some Observations And Findings In Selected Countries.* University Of Technology Malaysia Publication.

Hamsa, Abdul Azeez Kadar, Llyod C. Oniyirimba and Supian Ahmad. *An Exploratory Analysis of Factors Toward Emergence of Telecommuting in Malaysia*. Universiti Teknologi Malaysia.

Hamsa, Abdul Azeez Kadar (April 2002). *A Study on Teleworking Transportation and Environment in Malaysia.* Paper for JSPS-VCC Seminar on Sustainable Environment IIUM